

Using bird banding and recovery to study the migration of Black-necked Cranes (*Grus nigricollis*) in China

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Abstract: In this present study, by reorganizing and classifying the bird banding and recovery records from 1985 to 2012, we discussed the current research status of the migrations of Black-necked Cranes (*Grus nigricollis*) in China. The results showed that 94 Black-necked Cranes in total were banded and 13 among them were also attached with satellite transmitters. Whereas, only 66 counts were recovered, i.e., 27 or 28 birds (same color ring combinations were used on two individuals repeatedly, but were recovered at different places), indicating a recovery rate of 28.72% or 29.79%, while, most of the recovery (63 counts, 95.45%) happened in wintering sites. Data of banding showed that Black-necked Cranes hit their sexual maturity at the age ≥ 5 years, and the morphological indexes of the sub-adults are all smaller than those of the adults. After being banded, the average life span of banded individuals was 40 ± 40 months ($n=26$, 1–161 months). Moreover, the recovery records indicate three migration routes of Black-necked Cranes: (1) the eastern flyway: from the Greater Ruergai wetland area (breeding ground) of Sichuan and Gansu Provinces to northeastern Yunnan and northwestern Guizhou Provinces; (2) the central flyway: from the Longbaotan Nature Reserve of Qinghai Province (breeding ground, several other breeding sites along this route are located in northwest Sichuan Province) to the Napahai Natural Reserve, Yunnan Province (wintering ground); (3) from the vast area of northwestern Qinghai, Xinjiang, and northern Tibet (breeding ground) to the Yarlung Zangbo valley, southcentral Tibet and Bhutan. Our findings provide useful information to the relevant conservation and research facilities and institutes upon the banding, recovery and protection of the Black-necked Cranes. We recommend carrying out bird banding at breeding sites, while intensifying banding recovery and observation at wintering sites. Moreover, to establish long-term and stable information platforms and facilitate communication, it is urgent and necessary to standardize the banding and morphology measuring systems.

Keywords: *Grus nigricollis*; Bird migration; Color ring; Bird banding; Recovery of banded individuals

中国黑颈鹤的迁徙研究：环志与回收

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摘要: 该文对 1985—2012 年, 近 30 年中国境内的黑颈鹤 (*Grus nigricollis*) 环志与回收记录进行了整理和汇总, 以期弄清我国黑颈鹤迁徙研究的现状, 并为各黑颈鹤保护、管理和研究机构提供丰富的黑颈鹤环志与回收记录。研究结果显示: 我国共环志黑颈鹤个体 94 只, 其中 13 只佩戴有卫星发射器; 共计回收环志黑颈鹤 66 只次, 为 27 或 28 只黑颈鹤个体 (其中 2 只个体彩环组合重复, 并且在不同地点被观察到), 回收率为 28.72% 或 29.79%; 越冬地的回收 63 只次, 占 95.45%。环志回收数据证明了黑颈鹤种群存在的东、中、西三条迁徙路线, 即四川大若尔盖地区与滇东北黔西北一线、青海隆宝滩与滇西北纳帕海一线、青海西部和西藏中北部与西藏东南部和不丹一线。环志黑颈鹤揭示黑颈鹤的繁殖年龄为 ≥ 5 年, 未成年幼鹤的形态各方面指标皆小于成年鹤。环志之后的黑颈鹤个体野外存活的时间跨度平均为 44 ± 52 个月 ($n=26$), 最短为 1 个月, 最长 231 个月, 即近 20 年。考虑到黑颈鹤在繁殖地环志的优势与在越冬地回收的优势, 建议未来的迁徙研究工作可

增加在黑颈鹤繁殖地环志的力度，同时加大在越冬地观察带环黑颈鹤个体的强度。未来环志工作中应当制定统一的黑颈鹤环志和形态测量标准、建立长期稳定的信息共享平台和交流机制。

关键词：黑颈鹤；迁徙；鸟类环志；环志回收

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Migration is a regular seasonal movement of animals from breeding to wintering grounds. The phenomena of bird migration have fascinated biologists from time immemorial. To clarify the characters of migration and movements of birds, Newton (2008) classified birds' movement into six different types: everyday routine movements, one-way dispersal movements, migration, dispersive migration, irruptions or invasion migration and nomadism. Bird migration was then defined as a regular (back and forth) seasonal and long distance movement with clear directions between breeding grounds to wintering grounds (Newton, 2008). According to the residential situations of birds in different grounds, the birds can be categorized into three different types: residents, migrants (summer visitors and winter visitors) and vagrants.

The Black-necked Crane (*Grus nigricollis*) is a typical migrant species that mainly inhabits the Tibetan Plateau and the Yunnan-Guizhou Plateau. Every year, from October to November, they fly from the breeding grounds to the wintering grounds located at low altitude and low latitude areas, and then fly back to the breeding grounds from late March to early April (Li & Li, 2005). Up to now, the countries and areas (N20°–40°, E78°–108°) with recorded Black-necked Crane distributions include China, Bhutan, Nepal, Myanmar, Vietnam and Kashmir (Kong, 2012). The breeding grounds of Black-necked Cranes are concentrated on the Tibetan Plateau and its edgy areas (N31°–40°, E79°–104°, 2,600–5,000 m a.s.l.), including Tibet, Qinghai, Gansu, Sichuan and Xinjiang Provinces and Autonomous regions with breeding populations rarely being found in Kashmir (N33°–35°, E78°–79°) (Li & Li, 2005). However, during a survey conducted in Lop Nur Wild Camel National Nature Reserve, Ma et al (2011) also sighted Black-necked Cranes in the Akeqi valley (790 m a.s.l.). The wintering grounds (N25°–30°, E87°–105°, 1,900–3,900 m a.s.l.) of Black-necked Cranes mainly include the southeastern area of the Tibetan Plateau, the drainage areas of the Yarlung Zangbo River and its tributaries (Lhasa River and Nyang Qu River), the Yunnan-Guizhou

Plateau and the valleys in middle and northeastern Bhutan (Li & Li, 2005). According to the statistical results of Birdlife International (2009), there are approximately 11,000 Black-necked Cranes worldwide. Except for the wintering population with about 300 individuals in north Bhutan, few breeding pairs in Kashmir and scattered records at Myanmar and Vietnam, most of the Black-necked Cranes are distributed in China.¹

Studies on the migration of Black-necked Cranes can be tracked back to 1980s. Wu et al (1989, 1994) carried out studies on bird banding (21 individuals were banded with color rings) and recovery on the breeding populations in the Ruogai Nature Reserve, Sichuan Province (hereinafter referred to as Ruogai) and Longbaotan Nature Reserve (hereinafter referred to as Longbaotan), Qinghai Lake, Qinghai Province, as well as the wintering populations in Caohai Natural Reserve, Weining, Guizhou Province (hereinafter referred to as Caohai), and Napahai Natural Reserve, Shangri-La, Yunnan Province (hereinafter referred to as Napahai). In 2000, the International Crane Foundation (ICF) banded the breeding population (18 individuals) at the Shenzha plateau wetland, Tibet (hereinafter referred to as Shenzha) (Archibald, 2005). During wintering period of 1994–1995 and 2002–2003, ICF banded and observed 10 Black-necked Cranes at Caohai (Li, 1997, 2003). In February 1998, by collaborating with Wild Bird Society of Japan, ICF captured two juveniles and one adult Black-necked Crane at the wintering site of the Bomdeling valley, Bhutan, and attached one juvenile with a satellite

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transmitter. The satellite tracking results showed that during spring migration, this juvenile flew across the Himalaya Mountains, to the Xigaze area, Tibet, and then after a brief stop, reached Shenzha to spend its summer (the straight distance from the Bomdeling valley, Bhutan to Shenzha is approximately 480 km) (Archibald, 2005; Li & Li, 2005). From 2005–2007, the Kunming Institute of Zoology of Chinese Academy of Sciences (KIZ), ICF and the National Bird Banding Center of China (NBBC) worked together on a satellite tracking project of the Black-necked Crane populations in the Dashanbao Nature Reserve, Zhaotong, northeast Yunnan (hereinafter referred to as Dashanbao and Caohai. Via the satellite transmitters attached on eight Black-necked Cranes, the migration route between the breeding sites in Ruorgai, Sichuan to the wintering sites in northeast Yunnan and northwestern Guizhou Provinces, as well as the 13 stopover sites along the route were confirmed (the total migration distance was 674–713 km) (Gao et al, 2007; Qian et al, 2009). From 2008–2010, KIZ, Hong Kong (China) Exploration and Research Society, ICF and NBBC banded six Black-necked Cranes wintering in Napahai and then via the

satellite transmitters attached on five individuals, four novel breeding sites (including Daocheng, Litang, Baiyu and Xinlong Counties) were discovered (migration distance was 180 km, with five stopovers along the route) (Liu et al, 2012).

Based on previous studies, especially the banding and recovery records from Caohai, Dashanbao, Napahai and Ruorgai since 2004, this present study outlines the status of banding and recovery of Black-necked Cranes in China, providing basic information for the protection and studies of Black-necked Cranes, and is meaningful in promoting communication worldwide and facilitating the establishment of the protection network of Black-necked Cranes.

STUDY AREAS, MATERIALS AND METHODS

Study areas

The survey areas covered in this present study include the main breeding and wintering grounds of Black-necked Cranes: the Greater Ruergai area, Longbaotan, Shenzha, Caohai, Dashanbao, Napahai and the Black-necked Crane National Nature Reserve on the middle reaches of the Yarlung Zangbo River (Figure 1).



Figure 1 Black-necked Crane range map

Black lines are confirmed migration routes. Map made by Dorn Moore of International Crane Foundation

The Greater Ruorgai area, located in the northwestern section of Sichuan Province, includes Ruorgai, Hongyuan, Aba, Songpan Counties and the Maqu, Luqu Counties in southern Gansu Province. The main area, Ruorgai County (N32°20'–34°20', E102°00'–103°20'), is 3,400–4,000 m in altitude and is characterized with alpine cold and warm continental monsoon climate (Li & Li, 2005).

Longbaotan (N33°09'–33°17', E96°24'–96°37', 4,100–4,200 m a.s.l with surrounding mountains of 5,270 m a.s.l) is a long and narrow plateau basin (25 km from east to west, 4 km from south to north) located in Jielong town, Yushu County, Qinghai Province, and is characterized with Alpine cold and semi-humid continental climate (Li & Li, 2005).

Shenzha, located in the Nanqiangtang Lake basin (an area mostly formed from lakes in Tibet), is one of the major breeding habitats of Black-necked Cranes in north Tibet. This area is 4,500–5,000 m in altitude and is characterized with subalpine cold semi-arid monsoon climate (Li & Li, 2005).

Caohai, located in the suburb of Weining County, Guizhou Province, is a plateau wetland ecosystem protecting Black-necked Cranes and their wintering habitats. The entire area is 96 km², including the whole lake catchment area, while, the lake basin area is 47 km², including the Caohai Lake and surrounding swamps and wetlands (Li, 1999).

Dashanbao, located in Zhaoyang District, Zhaotong, Yunnan Province, includes the entire Dashanbao Township (N27°18'3"–27°29'15", E103°14'55"–103°23'49") and has 19,200 ha. It is a plateau with small mountain bodies with relatively similar altitudes and is characterized with subalpine semi-humid monsoon climate (Zhong & Dao, 2005).

Napahai, located in the northwestern part of Shangri-La County, Diqing Tibetan Autonomous Prefecture, northwestern Yunnan Province (N27°49'–27°55', E99°37'–99°43'), is a typical flat inter-mountain basin (3,266 m a.s.l, 10 km from south to north, 2.3–4.2 km from east to west) (Mu, 2007). The area is 3,435 ha with half in wetlands and the other half in meadows and farmland. The lake surface is 31.5 km² during high flow periods and most of the lake bodies are shallow swamps (Li & Yang, 2005).

The Black-necked Crane National Nature Reserve on the middle reaches of the Yarlung Zangbo River is a major wintering site, including 18 counties and areas

along the drainage areas of Yarlung Zangbo River and its tributaries (Lhasa River and Nyang Qu River) (Tsamchu & Bishop, 2005). It was extended to the grounds of the Pengbo Black-necked Crane Nature Reserve in 2003. The latter was 96.8 km² in area and is located in the Linzhou County, Lhasa. By then, the Yanghu area of Langkazi County, Shannan Region and the valley of the middle reaches of the Yarlung Zangbo River were all included in one nature reserve and renamed as the Black-necked Crane National Nature Reserve on the middle reaches of the Yarlung Zangbo River (N28°40'–30°17', E87°34'–91°54'). This renamed nature reserve involves three regions and six counties of Rikaze, Shannan and Lhasa Prefectures, is 614,350 ha in total area and can be divided into three major areas: (1) the Rikaze middle river valley area (252,068 ha) of the Yarlung Zangbo River, including Lazi, Rikazi, Nanmulin, Xietongmen and Sajia Counties; (2) the river valley (176,257 ha) of the drainage of Lhasa River, including Linzhou, Dazi and Mozugongka Counties; and (3) the wetlands of Yamdrok Lake (186,025 ha), including Langkazi and Gongga Counties (Xu et al, 2009).

Banding methods and materials

Applications and methods like loops, pursue nets, ensnared via mediator crane or direct capture of juveniles were used to capture individuals (Archibald, 2005; Wu et al, 1994). The captured individuals were banded with color PVC foot rings (from ICF) and metal rings (from NBBC and each one was engraved with a unique number). The PVC foot rings printed with or without numbers are in small (2 cm in width) or large sizes (5 cm in width) with six different colors, i.e., red, yellow, green, white, blue and orange. Since 2008, the ICF, NBBC and KIZ have reached an agreement to band Black-necked Cranes at Caohai (green), Dashanbao (yellow) and Napahai (red) with three-digit-numbered large color rings. The color rings were attached on the tibiotarsus of the tarsal metatarsal joint, while, the metal rings were on the tarsometatarsus.

Some of the banded individuals were also attached with the satellite transmitters provided by Microwave Telemetry Inc. (model PTT-100, length×width×height=94 mm×33 mm×30 mm, length of antenna=178 mm, weight=95 g (1.3%–1.7% of the average body weight of Black-necked Cranes (Gao et al, 2007)). The satellite transmitter was stabilized on the back of an individual by a polytetrafluoroethylene band crossing the chest. The

end of the band was sutured together with biodegradable materials, therefore, the satellite transmitter would eventually fall off on its own (Dwyer, 1972; Nagendran *et al.*, 1994).

The age of Black-necked Cranes can be estimated through their feather colors. The juveniles (<three months old) are covered with buffy down feathers, with pale colors showing on the neck and abdomen; flesh pink bills; flesh pink or grey tarsal metatarsal; incapable of flying. The sub-adults (4–10 months old) are covered with gray and pale feathers, with gray and brown colors showing on shoulders, back and wings; grayish black or yellow-brown feathers (usually seen in younger individuals) on head and neck; large areas of gray spots behind the eyes; gray brown tail feathers. The adults (>1 year old) are covered with gray feathers mixed with black or brown; 2/3 of the feathers on the head and neck are black with a red naked area on top of the head; gray spots behind eyes; flight feathers and tail feathers are dark brown; flesh pink bills with sage green at the tip and yellow at the corner; tarsal metatarsal, toes and feet in black (Li & Li, 2005). Because gender cannot be determined by morphological features, differences caused by sex were not discussed in here.

All the captured and banded individuals went through morphological measurements, including body weight, body length, wing length, tarsal metatarsal length, bill length and tail length. In this present study, the life

span (months) after being banded was defined as from the time the individual was initially banded to the last time this banded individual was observed.

Statistical analysis

All data were checked for normality by using Kolmogorov-Smirnov test. Because all the data were in normal distributions, the parametric test was used for statistical analysis (Zar, 1999). *T*-test with two independent samples was used to analyze the differences between adults and sub-adults. Data were analyzed by the two-tailed test via SPSS 16.0 (SPSS Inc., Chicago, USA). $P < 0.05$ was taken as a significant statistical difference.

RESULTS

Banding of Black-necked Cranes

The banding of Black-necked Cranes can be tracked back to 1985. Until 2012, 94 individuals in China were banded, including 38 adults, 18 sub-adults, 29 juveniles and 9 individuals of unknown age. Banding areas include Ruoergai, Longbaotan, Qinghaihu Lake, Bangetuoba wetland (Shenzha County, Tibet), three other breeding sites (Shenzha, Boluohu Lake and Mujiucuo), as well as three wintering sites (Dashanbao, Caohai and Napahai) (Table 1). Among the 13 banded individuals also carrying satellite transmitters, 7 were from Dashanbao, one was from Caohai, and 5 were from Napahai.

Table 1 Distribution and number of the banded Black-necked Cranes in China

Banding sites	Number of banded individuals (<i>n</i>)				
	Adults	Sub-adults	Juveniles	Unknown	Total
Ruoergai wetlands, Sichuan	5	1	2		8
Longbaotan wetlands and Qianghaihu Lake, Qinghai			9		9
Shenzha wetlands, Tibet			18		18
Napahai Nature Reserve, Yunnan	3	4			7
Dashanbao Nature Reserve, Yunnan	20	6		3	29
Caohai Nature Reserve, Yunnan	10	6		5	21
Unknown		1		1	2
Total	38	18	29	9	94

Recovery of the banded Black-necked Cranes

During field observations, 66 counts of banding recovery, i.e., 27 or 28 birds (same color ring combinations were used repeatedly on two individuals banded in Shenzha, but were recovered at different places), indicating a recovery rate of 28.72% or 29.79%. Sixty-three counts (95.45%)

were discovered at the wintering sites and only three counts were discovered at the breeding sites of Ruoergai (Table 2).

Migration routes from breeding sites to wintering sites

The Black-necked Cranes banded at breeding sites were recorded 10 or 11 counts (7 or 8 individuals) at

wintering sites, i.e., 2 individuals banded at Ruorgai were recorded in Caohai, 1 individual banded at Longbaotan was recorded in Napahai, 4 or 5 individuals banded at Shenzha, were recorded in the surrounding areas of Rikaze, the Yarlung Zangbo Valley, Tibet. One crane banded at Dashanbao was recorded at Gahai Nature Reserve, Gansu (Table 3).

Movements between wintering sites

Eight Black-necked Cranes (17 counts) banded

at Caohai were discovered at wintering sites, i.e., 5 individuals (12 counts) were observed repeatedly at Caohai, 1 individual (1 counts) was observed at Wenping Town, Ludian County, Yunnan, 1 individual (2 counts) was observed at Dashanbao, 1 individual (2 counts) was observed at Mashu Town, Qiaojia County, Yunnan. Among the other 10 individuals (32 counts) banded at Dashanbao, 8 individuals (30 counts) were observed repeatedly at Dashanbao, while, only 2 individuals were observed at Caohai (Table 4).

Table 2 Recovery records of the banded Black-necked Cranes in China

Recovery sites		Counts (<i>n</i>)	Individuals (<i>n</i>)
Sichuan	Ruorgai wetlands	3	3
Tibet	The Yarlung Zangbo Valley	8	4/5
Guizhou	Caohai Nature Reserve	17	10
	Dashanbao Nature Reserve	34	10
	Wenping Town, Ludian County	1	1
	Mashu Town, Qiaojia County	2	1
	Napahai Nature Reserve, Shangri-La	1	1
Total		66	

Table 3 Migration routes confirmed by the banding and recovery records of Black-necked Cranes in China

Breeding site to wintering site	Counts (<i>n</i>)	Individuals (<i>n</i>)
Ruorgai Nature Reserve, Sichuan to Caohai Nature Reserve, Guizhou	2	2
Gahai Nature Reserve, Gansu to Dashanbao Nature Reserve, Yunnan	1	1
Longbaotan Nature Reserve, Qinghai to Napahai Nature Reserve, Yunnan	1	1
Shenzha, Tibet to the YarlungZangboValley, Tibet	7/8	4/5
Total	11/12	8/9

Table 4 Movements between wintering sites indicated by the banding and recovery records of Black-necked Cranes in China

Wintering site to wintering site	Counts (<i>n</i>)	Individuals (<i>n</i>)
Caohai Nature Reserve, Guizhou to Caohai Nature Reserve, Guizhou	12	5
Caohai Nature Reserve, Guizhou to Dashanbao Nature Reserve, Yunnan	2	1
Caohai Nature Reserve, Guizhou to Wenping Village, Zhaotong, Yunnan	1	1
Caohai Nature Reserve, Guizhou to Mashu Village, Qiaojia, Yunnan	2	1
Dashanbao Nature Reserve, Yunnan to Dashanbao Nature Reserve, Yunnan	30	8
Dashanbao Nature Reserve, Yunnan to Caohai Nature Reserve, Guizhou	2	2
Total	49	18

Morphological measurements

The body weight, body length ($F_{38}=4.99$, $P=0.031$), wing length ($F_{33}=4.96$, $P=0.033$), tarsal

length, bill length and tail length of adults were all higher or significantly higher than those of the sub-adults (Table 5).

Table 5 Morphological differences between adult and sub-adult Black-necked Cranes

	Adult		Sub-adult		Statistical parameters			Li & Li, 2005
	Mean	<i>n</i>	Mean	<i>n</i>	<i>F</i>	<i>df</i>	<i>P</i>	
Body weight (g)	6172.55±665.91	31	5825.00±887.26	10	1.33	39	0.255	5055
Body Length (cm)	119.80±11.33	30	113.18±6.52	10	4.99	38	0.031*	117.35
Wing Length (cm)	70.45±11.15	26	62.36±6.67	9	4.96	33	0.033*	57.5
Tarsal Length (cm)	24.54±2.04	27	24.31±2.16	9	0.08	34	0.775	23.9
Bill Length (cm)	12.31±1.03	25	11.69±0.98	9	0.28	32	0.603	11.75
Tail Length (cm)	25.67±4.02	25	23.94±2.57	9	0.71	32	0.406	22.4

**P*<0.05.

The reproductive age of Black-necked Cranes

The banding and recovery records showed that one sub-adult Black-necked Crane banded (right leg, red ring, No. 140) on December 16, 1986, Guizhou, was sighted during the winter of 1991–1992 and 1992–1993 with family members comprised of 2 adults/1 juvenile and 2 adults/2 juveniles, respectively. A sub-adult banded (left-green-red, right-green) at Dashanbao on March 12, 2009 was observed uncoupled until January 14, 2014. Therefore, we assumed that adult ≥5-year-old is capable of reproduction.

The life span after banding

Based on available banding and recovery data, we assumed that the average life span of banded Black-necked Cranes was 40±40 months (*n*=26, 1–161 months).

DISCUSSION

The banding and recovery of Black-necked Cranes

In China, studies on the migration of Black-necked Cranes can be tracked back to the 1980s. Ninety-four Black-necked Cranes in total were banded [35 (37.23%) individuals were banded at breeding sites, 57 (60.64%) were banded at wintering sites and 2 were unknown] and 13 of them were also carrying satellite transmitters. Fewer individuals were banded in breeding sites than in wintering sites and were all done before 2000. Since 2000, all of the bird banding was finished at the wintering sites. Relatively, juveniles and sub-adults are easier to capture and are more beneficial in the later tracking of their development and reproduction. The majority (31, 85.71%) of the banded individuals (35) at breeding sites were juveniles (30) and sub-adults (1). Therefore, we suggest that in the future, breeding sites should be used as the bird banding sites.

The recovery data showed 66 (28.72% or 29.79%)

observation counts (27 or 28 individuals) in total and 63 (95.45%) of them were from the wintering sites, while only 3 counts were from the breeding sites of Ruogai. Li & Li (2005) claimed that because the Black-necked Cranes were more scattered due to the widely spread geographic conditions of breeding sites and also because of the large numbers of swamps and lakes in these areas, it was difficult for observers to get close to the individuals, therefore the recovery rates of breeding sites were low, whereas, at wintering sites, individuals were distributed in relatively small areas and were easier to approach. So, we suggest that observation of banded individuals at wintering sites should be reinforced.

The off-site recovery data showed that 7 or 8 individuals (10 or 11 counts) banded at breeding sites were observed at wintering sites and one bird banded at a wintering site was observed at a breeding site, while, 17 individuals (49 counts) banded at wintering sites were observed at wintering sites. We assumed that the off-site numerical differences in recovery rates were caused by two reasons: (1) the absolute number of banded individuals at the breeding site was smaller than that of the wintering site; (2) the individuals banded at a wintering site were more likely to be observed at the same wintering site. The goal of migration study is to determine the connections between breeding sites and wintering sites of certain species and movement patterns of these species among different locations. Therefore, in the future, to be able to observe more individuals at the wintering sites, more individuals should be banded both at the breeding and the wintering sites, consequently, more abundant data could be acquired to determine the migration routes and winter movements of the Black-necked Cranes.

Although the combinations of PVC color rings and metal rings were applied in all the studies, in the field

survey, individuals could only be identified by the color rings or numbers, while, the metal rings were unable to be clearly read and could merely be used as indications of being banded. Based on field experience, small color rings (width=2 cm) are the most easily recognized, whereas, the number reading on the large color rings (width=5 cm) can be significantly affected by weather conditions. However, due to the limited combinations of smaller color rings, they cannot meet the requirement of banding massive populations, so large color rings combined with numbers are still the optimal banding choice. Moreover, red, yellow and green are easier to spot than orange, blue and white. And natural fall off is observed in both the colored and metal rings.

The migration routes of Black-necked Cranes

Three migration routes were confirmed by the banding and recovery data of Black-necked Cranes: (1) from Ruorgai to Caohai and from Gahai to Dashabao, i.e., Black-necked Cranes that breed at the Greater Ruorgai wetlands (including Maqu and Luqu Counties, south Gansu) are wintering in northeast Yunnan and northwestern Guizhou (including Caohai, Dashanbao, Huize and Xundian). Individuals that migrate along this route are considered as the east population and this migration route was validated by satellite tracking (Gao et al, 2007; Qian et al, 2009). The stopovers along this route include Jinyang, Meigu, Ganluo, Shimian, Hanyuan, Luding, Tianquan, Lixian, Hongyuan and Aba Counties, Sichuan (Gao et al, 2007); (2) from Longbaotan (breeding area) to Napahai (wintering area) (Wu et al, 1994). Populations using this route are considered the middle population. However, satellite tracking results showed that 5 individuals wintering in Napahai did not migrate back to Qinghai, but stopped at Daocheng, Litang, Baiyu and Xinlong Counties in western Sichuan instead (Liu et al, 2012). The local survey conducted by Wang et al (2013) also indicates that the Haizishan National Nature Reserve located at Daocheng and Litang Counties, Tibetan Autonomous Prefecture of Garze, Sichuan, is an important breeding site and stopover of the migration of Black-necked Cranes, and 51 adults and 5 sub-adults were observed there; (3) from Shenzha to Rikaze, Tibet, i.e., Black-necked Cranes breeding in southeast Xinjiang and west Qinghai fly across the Tanggula Mountain Pass, while the individuals breeding in north and northwest Tibet migrate from high altitude areas toward the south or

southeast to low altitude areas (Yarlung Zangbo valley and the middle section valleys of its tributaries). Some individuals breeding in Shenzha wetlands, north Tibet fly across the Himalaya Mountains and spend the winter in Bhutan (Archibald, 2005; Wu et al, 1994). These populations are the west populations. Although so far, no direct evidence can prove the wintering sites of the populations of west Qinghai and Xingjiang, via the population size in East Kunlun-Altun Mountain, Xinjiang, it can be assumed that these populations are wintering in the valleys of Yarlung Zangbo River and its tributaries. The survey conducted from September–November, 2011 discovered 126 individuals in the East Kunlun-Altun Mountain area, indicating a population of 220–260 individuals in this area (Zhang et al, 2012).

Morphological measurements

In this present study, we found that the body weight, body length ($F_{38}=4.99$, $P=0.031$), wing length ($F_{33}=4.96$, $P=0.033$), tarsus length, bill length and tail length of adults were all higher or significantly higher than those of the sub-adults (Table 5), which is inconsistent with the results of Li & Li (2005) (except body length of sub-adults, all measurements of Li & Li (2005) were smaller than those in this present study) (Table 5). We assume these differences were due to the bias from different observers.

Suggestions

In summary, the banding and recovery studies over the past 30 years had banded large numbers of Black-necked Cranes and have provided important information of the migration of this species. However, there are still issues that need to be resolved, such as low recovery rate, unorganized color ring combinations, lack of standards and inefficient communication or data sharing. Under these circumstances, we suggest: (1) create a nation-wide communication network of Black-necked Cranes involving the related nature reserves, forestry departments, colleges and institutes. By using this network, the utilization of standard color rings and metal rings should be promoted and the research or protection results should be shared; (2) establish a long-term and stable platform for information communicating and sharing which is open to all network members; (3) the capture, banding and measuring of Black-necked Cranes should be carried out under professional direction and be well organized; (4) set up a standard system of banding. For example, a

combination of large and small color rings should be adopted. Individuals banded in breeding sites would be attached with small rings on left legs and large rings on right legs, whereas, birds banded in wintering sites would be attached with large rings on left legs and small rings on right legs. Large rings are labeled with one letter and two digits. Breeding sites be labeled with large green rings numbered with “B” plus two digits (01–99), while, wintering sites be labeled with large red rings numbered with “W” plus two digits (01–99). Small color rings be used to differentiate banding sites (breeding site or wintering site), i.e, smaller green rings represent Greater Ruoergai area and Dashanbao, smaller yellow rings represent Caohai, smaller orange rings represent Huize County, Qujing, Yunnan, smaller red rings represent Longbaotan and Napahai, smaller white rings represent the breeding sites of north Tibet and wintering sites of Yarlung Zangbo River, smaller blue rings represent Aershichin, Xinjing and Qinghaihu Lake. For example, the first Black-necked Crane to be banded in Dashanbao

would carry a large red ring labeled with “W01” on the left leg and small green ring on the right leg, while, the second Black-necked Crane banded in Ruoergai would carry large green ring labeled with “B02” on the right leg and small green ring on the left leg.

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Appendix 1 The color ring banded Black-necked Cranes in China

Bird number	Date of banding	Banding site	Numbers of metal rings	Number of satellite transmitters (PPT)	Number and position of color rings		Physical measurement						References	
					Left leg (top/middle/end)	Right leg (top/middle/end)	Age	Body weight (g)	Body length (cm)	Wing length (cm)	Tarsal length (cm)	Bill length (cm)		Tail Length (cm)
#1	1985-01-26	Caohai	00-0501	-	-	-	Red, white 100	Sub-adult	-	-	-	-	-	Wu et al, 1994
#2	1985-03-15	Caohai	00-0521	-	-	-	Red, white 101	Sub-adult	-	-	-	-	-	Wu et al, 1994
#3	1986-06-21 1986-07-20	Ruergai	-	-	-	Red	Orange, black 2	Juvenile	-	-	-	-	-	Wu et al, 1994
#4	1986-06-21 1986-07-20	Ruergai	-	-	-	Red	Orange, black 3	Juvenile	-	-	-	-	-	Wu et al, 1994
#5	1986-12-16	Caohai	-	-	-	-	Red, 140	Sub-adult	-	-	-	-	-	Wu et al, 1994
#6	1987-02-08	Caohai	-	-	-	-	Orange, black 4	Sub-adult	-	-	-	-	-	Wu et al, 1994
#7	1987-06-02	Longbaotan	-	-	-	Green	-	Juvenile	-	-	-	-	-	Wu et al, 1989
#8	1987-06-06	Longbaotan	-	-	-	Green	-	Juvenile	-	-	-	-	-	Wu et al, 1989
#9	1987-06-21	Longbaotan	-	-	-	Green	-	Juvenile	-	-	-	-	-	Wu et al, 1989
#10	1987-06-23	Longbaotan	-	-	-	Green	-	Juvenile	-	-	-	-	-	Wu et al, 1989
#11	1987-06-23	Longbaotan	-	-	-	Green	-	Juvenile	-	-	-	-	-	Wu et al, 1989
#12	1987-07-03	Qinghaihu Lake	-	-	-	White	-	Juvenile	-	-	-	-	-	Wu et al, 1989
#13	1987-12-07	Ruergai	00-0706	-	-	Red, white 160	-	Adult	-	-	-	-	-	Wu et al, 1994
#14	1987-12-07	Ruergai	00-0705	-	-	Red, white 161	-	Adult	-	-	-	-	-	Wu et al, 1994
#15	1987-12-07	Ruergai	00-0708	-	-	Red, white 162	-	Adult	-	-	-	-	-	Wu et al, 1994
#16	1987-12-07	Ruergai	00-0707	-	-	Red, white 163	-	Adult	-	-	-	-	-	Wu et al, 1994
#17	1987-12-07	Ruergai	00-0709	-	-	Red, white 164	-	Adult	-	-	-	-	-	Wu et al, 1994
#18	1987-12-07	Ruergai	-	-	-	Red, white 3	-	Sub-adult	-	-	-	-	-	Wu et al, 1994

(Continued)

Bird number	Date of banding	Banding site	Numbers of metal rings	Number of satellite transmitters (PPT)	Number and position of color rings		Physical measurement						References	
					Left leg (top/middle/end)	Right leg (top/middle/end)	Age	Body weight (g)	Body length (cm)	Wing length (cm)	Tarsal length (cm)	Bill length (cm)		Tail Length (cm)
#19	1988-06-24	Longbaotan	-	-	White	-	Juvenile	-	-	-	-	-	-	Wu et al, 1994
#20	1988-06-25	Longbaotan	-	-	White	-	Juvenile	-	-	-	-	-	-	Wu et al, 1994
#21	1988-06-25	Longbaotan	-	-	White	-	Juvenile	-	-	-	-	-	-	Wu et al, 1994
#22	1994-12-04	Caohai	N00-9243	-	White	Red-red	-	-	-	-	-	-	-	Li, 1997
#23	1994-12-04	Caohai	N00-9242	-	White/red	Green	-	-	-	-	-	-	-	Li, 1997
#24	1994-12-06	Caohai	N00-9250	-	Green/green	Red	-	-	-	-	-	-	-	Li, 1997
#25	1995-01-20	Caohai	M00-5459	-	Red/green	White	-	-	-	-	-	-	-	Li, 1997
#26	1995-01-22	Caohai	M00-5452	-	White	Red/white	-	-	-	-	-	-	-	Li, 1997
#27	2000-07-14	Shenzhen wetlands	-	-	Yellow	-	Juvenile	-	-	-	-	-	-	Archibald, 2005
#28	2000-07-15	Shenzhen Luobuohu Lake	-	-	-	White	Juvenile	-	-	-	-	-	-	Archibald, 2005
#29	2000-07-15	Shenzhen Luobuohu Lake	-	-	White	-	Juvenile	-	-	-	-	-	-	Archibald, 2005
#30	2000-07-16	Shenzhen Luobuohu Lake	-	-	-	Yellow	Juvenile	-	-	-	-	-	-	Archibald, 2005
#31	2000-07-16	Shenzhen Luobuohu Lake	-	-	-	Red	Juvenile	-	-	-	-	-	-	Archibald, 2005
#32	2000-07-17	Shenzhen Luobuohu Lake	-	-	Blue	White	Juvenile	-	-	-	-	-	-	Archibald, 2005*
#33	2000-07-17	Shenzhen Luobuohu Lake	-	-	White	Red	Juvenile	-	-	-	-	-	-	Archibald, 2005
#34	2000-07-17	Shenzhen Luobuohu Lake	-	-	Red	White	Juvenile	-	-	-	-	-	-	Archibald, 2005
#35	2000-07-18	Shenzhen Luobuohu Lake	-	-	Red	-	Juvenile	-	-	-	-	-	-	Archibald, 2005
#36	2000-07-20	Shenzhen Mujiucuo	-	-	Yellow	Yellow	Juvenile	-	-	-	-	-	-	Archibald, 2005
#37	2000-07-21	Shenzhen Mujiucuo	-	-	Yellow	Blue	Juvenile	-	-	-	-	-	-	Archibald, 2005*

(Continued)

Bird number	Date of banding	Banding site	Numbers of metal rings	Number of satellite transmitters (PPT)	Number and position of color rings		Physical measurement							References	
					Left leg (top/middle/end)	Right leg (top/middle/end)	Age	Body weight (g)	Body length (cm)	Wing length (cm)	Tarsal length (cm)	Bill length (cm)	Tail Length (cm)		
#38	2000-07-21	Shenzhen Mujiucuo	-	-	White	Blue	Juvenile	-	-	-	-	-	-	-	Archibald, 2005
#39	2000-07-21	Shenzhen Mujiucuo	-	-	Yellow	White	Juvenile	-	-	-	-	-	-	-	Archibald, 2005
#40	2000-07-24	Bangatuoba wetlands	-	-	Blue	White	Juvenile	-	-	-	-	-	-	-	Archibald, 2005*
#41	2000-07-24	Bangatuoba wetlands	-	-	White	Yellow	Juvenile	-	-	-	-	-	-	-	Archibald, 2005
#42	2000-07-24	Bangatuoba wetlands	-	-	Red	Red	Juvenile	-	-	-	-	-	-	-	Archibald, 2005
#43	2000-07-24	Bangatuoba wetlands	-	-	Blue	Red	Juvenile	-	-	-	-	-	-	-	Archibald, 2005
#44	2000-07-25	Bangatuoba wetlands	-	-	Yellow	Blue	Juvenile	-	-	-	-	-	-	-	Archibald, 2005*
#45	2003-03-07	Yazitang Lake, Caohai	N00-6403	-	-	Green/yellow	Adult	6250	110						Li, 2003
#46	2003-03-14	Yazitang Lake, Caohai	N00-6404	-	-	Green/red	Sub-adult	6000	109						Li, 2003
#47	2003-03-14	Guoguoshan Mountain, Caohai	N00-6405	-	Green/yellow	-	Adult	6750	115						Li, 2003
#48	2003-03-15	Yazitang, Caohai	N00-6406	-	Green/red	-	Adult	6000	112						Li, 2003
#49	2003-03-15	Huyelin, Caohai	N00-6407	-	Red/yellow	-	Adult	6500	125						Li, 2003
#50	2004-12-22	Caohai	-	-	-	Red/yellow	Adult								Present study
#51	2005-02-26	Daniuwo, Dashanbao	N01-3318	No : 55983	Green/green	-	Adult	5500	117	68	24	12	36		Present study
#52	2005-02-26	Xiaohaiba, Dashanbao	M01-0528	No : 55981	Red/green/yellow	-	Adult	7500	119	70	23	13	39		Present study
#53	2005-02-28	Xiaohaiba, Dashanbao	M01-0523	-	Green	Green	Adult	6300	119	65	26		24		Present study

(Continued)

Bird number	Date of banding	Banding site	Numbers of metal rings	Number of satellite transmitters (PPT)	Number and position of color rings		Physical measurement							References
					Left leg (top/middle/end)	Right leg (top/middle/end)	Age	Body weight (g)	Body length (cm)	Wing length (cm)	Tarsal length (cm)	Bill length (cm)	Tail Length (cm)	
#54	2005-03-01	Dahaizi, Dashanbao	N00-6570	No : 55982	Green	Yellow	Adult	6500	122	66	26	12	27	Present study
#55	2005-03-01	Dahaizi, Dashanbao	N00-6569	No : 55984	Yellow	Green	Adult	5500	111	62	25		22	Present study
#56	2005-04-07	Dahaizi, Dashanbao	N00-6566	-	Red	Yellow	-	4000	105	58	23	11	24	Present study
#57	2005-04-09	Dahaizi, Dashanbao	N00-6568	-	Yellow	Red	-	5500	118	66	24	13	33	Present study
#58	2006-02-28	Yazitang, Caohai	N00-6410	No : 64311	Yellow/red	-	Adult	6250	117	63	28	14	22	Present study
#59	2006-03-02	Yazitang, Caohai	N00-6409	-	Red/green	-	Adult	7000	122	62	24	11	24	Present study
#60	2006-03-03	Zhujiawan, Caohai	N00-6408	-	-	Yellow/red	Adult	6500	130	66	24	11	25	Present study
#61	2006-03-04	Zhujiawan, Caohai	-	-	-	Yellow/green	Adult	6500	130	72	24	12	25	Present study
#62	2006-03-06	Huyelin, Caohai	-	-	-	Yellow	Adult	5750	127	70	25	12.5	26.5	Present study
#63	2006-03-14	Wujiayatou, Caohai	-	-	Green	Red/yellow	Sub-adult	5000	110	58	25.5	11	23.5	Present study
#64	2006-03-18	Lelizhai, Dashanbao	-	No : 64312	Yellow/green/red	-	Adult	5759	110	67	25	10.5	23	Present study
#65	2006-03-18	Xiaohaiba, Dashanbao	-	No : 64310	-	Yellow/green/red	Adult	6000	120	62	27	13	26	Present study
#66	2006-03-20	Dahaizi, Dashanbao	-	No : 64309	Red/yellow	Red/yellow	Adult	6500	120	72	27	13	22	Present study
#67	2006-04-05	Dahaizi, Dashanbao	N00-6566	-	Red	Yellow	-	-	-	-	-	-	-	Present study
#68	2008-03-25	Dahaizi, Dashanbao	-	-	Red	Red/yellow	Sub-adult							Present study
#69	2008-11-03	Napahai, Shangri-La	-	-	-	Large red ring, white 007	\Adult	5500			24	12.4		Liu et al, 2012

(Continued)

Bird number	Date of banding	Banding site	Numbers of metal rings	Number of satellite transmitters (PPT)	Number and position of color rings		Physical measurement							References
					Left leg (top/middle/end)	Right leg (top/middle/end)	Age	Body weight (g)	Body length (cm)	Wing length (cm)	Tarsal length (cm)	Bill length (cm)	Tail Length (cm)	
#70	2009-02-21	Napahai, Shangri-La	M01-6866	No. : 79631	Red	Large red ring, white 006	Sub-adult	6000	114	60	21	13	30	Liu et al, 2012
#71	2009-03-12	Dahaizi, Dashanbao	M01-6863	-	Yellow/green	-	Adult	-	-	-	-	-	-	Present study
#72	2009-03-12	Dahaizi, Dashanbao	M01-6867	-	Green/red	Green	Sub-adult	-	-	-	-	-	-	Present study
#73	2009-03-14	Napahai, Shangri-La	-	No. : 79629	Yellow	Large red ring, white 005	Sub-adult	5500	112	60.1	22	11.7	25	Liu et al, 2012
#74	2009-11-01	Napahai, Shangri-La	M01-6865	No. : 79627	Red/yellow	Large red ring, white 004	Adult	5250	105	61	24	10.8	-	Liu et al, 2012
#75	2009-11-06	Napahai, Shangri-La	M01-686?	No. : 79630	Yellow/red	Large red ring, white 001	Sub-adult	5200	116	62	25	10.7	24	Liu et al, 2012
#76	2009-11-16	Napahai, Shangri-La	M01-6869	No. : 79628	Yellow/green/yellow	Large red ring, white 008	Adult	5000	108	59	24	11.5	23	Liu et al, 2012
#77	2010-01-10	Xiaohaiba, Dashanbao	Q02-1342	-	Large yellow ring, white 001	-	Adult	6000	114	62	27	11.2	26	Present study
#78	2010-01-26	Changhuikou, Dashanbao	Q02-1355	-	Large yellow ring, white 012	-	Adult	6000	130	84	22	12	25	Present study
#79	2010-01-27	Xiaohaiba, Dashanbao	Q02-1343	-	Large yellow ring, white 017	-	Sub-adult	5500	130	79	22	10	21	Present study
#80	2010-02-03	Xiaohaiba, Dashanbao	Q02-1344	-	Large yellow ring, white 016	-	Adult	6500	144	88	21	14	26	Present study
#81	2010-02-04	Xiaohaiba, Dashanbao	Q02-1354	-	Large yellow ring, white 014	-	Adult	6000	133	86	21	13	24	Present study
#82	2010-03-03	Xiaohaiba, Dashanbao	Q02-1345	-	Large yellow ring, white 010	-	Adult	6000	130	93	21	13	28	Present study
#83	2010-03-04	Changhuikou, Dashanbao	Q02-1346	-	Large yellow ring, white 023	-	Adult	5500	110	86	25	14	27	Present study
#84	2010-03-10	Napahai, Shangri-La	-	-	Green/red	Large red ring, white 002	Sub-adult	4850	111	60	25	12	22	Present study
#85	2010-03-11	Dahaizi, Dashanbao	Q02-1347	-	Large yellow ring, white 015	-	Adult	5500	104	59.2	22	11.8	23.5	Present study

(Continued)

Bird number	Date of banding	Banding site	Numbers of metal rings	Number of satellite transmitters (PPT)	Number and position of color rings			Physical measurement					References	
					Left leg (top/middle/end)	Right leg (top/middle/end)	Age	Body weight (g)	Body length (cm)	Wing length (cm)	Tarsal length (cm)	Bill length (cm)		Tail Length (cm)
#86	2010-03-11	Dahaizi, Dashanbao	Q02-1356	-	Large yellow ring, white 018	-	Adult	6000	104	59	23.5	12.2	23.4	Present study
#87	2010-03-18	Xiaohaiba, Dashanbao	Q02-1350	-	Large yellow ring, white 020	-	Sub-adult	5500	110.8	60.5	24.5	11.8	24.2	Present study
#88	2012-02-23	Dahaizi, Dashanbao	Q02-1349	-	Large yellow ring, white 025	-	Adult	8340	105	56.6	25.6	11.3	21.4	Present study
#89	2012-02-23	Dahaizi, Dashanbao	Q02-1357	-	Large yellow ring, white 021	-	Sub-adult	7220	113	56.6	27	12.8	23.3	Present study
#90	2012-02-23	Dahaizi, Dashanbao	Q02-1358	-	Large yellow ring, white 026	-	Sub-adult	7480	106	65	26.8	12.2	22.5	Present study
#91	2012-03-06	Xiaohaiba, Dashanbao	-	-	Large yellow ring, white 022	-	Adult	6500	144	88	28	13.5	26	Present study
#92	2012-03-21	Dahaizi, Dashanbao	Q02-1306	-	Large yellow ring, white 027	-	Adult	6200	137	85	26.5	13.1	27	Present study
#93	N/A	N/A			Yellow flag ring	Red/green	-							
#94	N/A	N/A		-	-	Large yellow ring, white 029	Sub-adult							Present study

*: Color ring combinations were used repeatedly.

Appendix 2 Recovery records of the banded Black-necked Cranes in China

Bird number	Recovery information			Banding information		
	Date	Site	Observer	Date	Site	
#1	1986	Caohai	Wu et al, 1994	1985-01-26	Caohai	
#1	1987	Caohai	Wu et al, 1994	1985-01-26	Caohai	
#1	1988	Caohai	Wu et al, 1994	1985-01-26	Caohai	
#2	1985	Caohai	Wu et al, 1994	1985-03-15	Caohai	
#2	1986	Caohai	Wu et al, 1994	1985-03-15	Caohai	
#3	1987-10-03	Ruoergai	Wu et al, 1994	1986-06-21	Ruoergai	
#4	1987-10-03	Ruoergai	Wu et al, 1994	1986-07-20	Ruoergai	
#4	1987-11-13	Caohai	Wu et al, 1994	1986-06-21	Ruoergai	
#5	1989-1990	Caohai	Wu et al, 1994	1986-07-20	Ruoergai	
#5	1990-1991	Caohai	Wu et al, 1994	1986-12-16	Caohai	
#5	1991-1992	Caohai	Wu et al, 1994	1986-12-16	Caohai	
#5	1992-1993	Caohai	Wu et al, 1994	1986-12-16	Caohai	
#5	1993-1994	Caohai	Zhang et al	1986-12-16	Caohai	
#16	1988-03-27	Caohai	Wu et al, 1994	1987-12-07	Ruoergai	
#19	1988-11-14	Napahai, Shangri-La	Wu et al, 1994	1988-06-24	Longbaotan	
#31	Winter, 2005	Bianna Village, Rikaze, Tibet	Archibald, 2005	2000-07-16	Luobuohu, Shenzha	
#35	Winter, 2001	Valley of Brahmaputra River, Tibet	Archibald, 2005	2000-07-18	Luobuohu, Shenzha	
#35	2013-12-?	Rikaze, Tibet	Forestry Bureau, Rikaze, Tibet	2000-07-18	Luobuohu, Shenzha	
#35	2004-03-06	Bianxiong Village, Rikaze, Tibet	China crane news, 2004	2000-07-18	Luobuohu, Shenzha	
#35	Winter, 2004	Valley of Brahmaputra River, Tibet	Archibald, 2005	2000-07-18	Luobuohu, Shenzha	

(Continued)

Bird number	Recovery information		Banding information		
	Date	Site	Observer	Date	Site
#66	2007-01-27	Longjiadadi, Dashanbao	Kong	2006-03-20	Dahaizi, Dashanbao
#66	2007-03-10	Dahaizi, Dashanbao	Kong	2006-03-20	Dahaizi, Dashanbao
#66	2007-03-20	Dahaizi, Dashanbao	Kong	2006-03-20	Dahaizi, Dashanbao
#66	2007-03-21	Dahaizi, Dashanbao	Kong & Chen	2006-03-20	Dahaizi, Dashanbao
#67	2007-03-26	Dahaizi, Dashanbao	Kong & Anonymous	2006-04-05	Dahaizi, Dashanbao
#71	2008-03-01	Caohai	Anonymous	2009-03-12	Dahaizi, Dashanbao
#72	2009-11-14	Dahaizi, Dashanbao	Kong	2009-03-12	Dahaizi, Dashanbao
#72	2010-12-04	Dahaizi, Dashanbao	Zhu	2009-03-12	Dahaizi, Dashanbao
#72	2010-12-06	Dahaizi, Dashanbao	Zhu	2009-03-12	Dahaizi, Dashanbao
#72	2011-11-22	Dahaizi, Dashanbao	Kong	2009-03-12	Dahaizi, Dashanbao
#72	2011-11-25	Dahaizi, Dashanbao	Kong	2009-03-12	Dahaizi, Dashanbao
#72	2011-12-10	Dahaizi, Dashanbao	Kong	2009-03-12	Dahaizi, Dashanbao
#72	2011-12-12	Dahaizi, Dashanbao	Kong	2009-03-12	Dahaizi, Dashanbao
#72	2014-01-10	Dahaizi, Dashanbao	Kong	2009-03-12	Dahaizi, Dashanbao
#72	2014-01-14	Dahaizi, Dashanbao	Kong	2009-03-12	Dahaizi, Dashanbao
#77	2010-11-16	Changhuikou, Dashanbao	Zhu	2010-01-10	Xiaohaiba, Dashanbao
#82	2011-03-08	Xiaohaiba, Dashanbao	Zhu & Li	2010-03-03	Xiaohaiba, Dashanbao
#87	2011-03-08	Xiaohaiba, Dashanbao	Zhu & Li	2010-03-18	Xiaohaiba, Dashanbao
#93	2008-03-01	Caohai	Anonymous	N/A	N/A
#94	2011-03-08	Dahaizi, Dashanbao	Zhu & Li	N/A	N/A
#94	2011-11-23	Dahaizi, Dashanbao	Kong	N/A	N/A
#94	2012-04-16	209 highway, Hongyuan County, Sichuan	Liu & Tang	N/A	N/A